No. 200000353

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

The Regents of the University of California

Whereas, THERE HAS BEEN PRESENTED TO THE

Secretary of Agriculture

AN APPLICATION REQUESTING A CERTIFICATE OF PROTECTION FOR AN ALLEGED DISTINCT VARIETY OF SEXUALLY REPRODUCED, OR TUBER PROPAGATED PLANT, THE NAME AND DESCRIPTION OF WHICH ARE CONTAINED IN THE APPLICATION AND EXHIBITS, A COPY OF WHICH IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PLANT VARIETY PROTECTION OFFICE, IN THE APPLICANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID APPLICANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A CERTIFICATE OF PLANT VARIETY PROTECTION UNDER THE LAW.

NOW, THEREFORE, THIS CERTIFICATE OF PLANT VARIETY PROTECTION IS TO GRANT UNTO THE SAID APPLICANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID APPLICANT(S) FOR THE TERM OF TWENTY YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF THE REQUIRED FEES AND PERIODIC REPLENISHMENT OF VIABLE BASIC SEED OF THE VARIETY IN A PUBLIC REPOSITORY AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM SELLING THE VARIETY, OR OFFERING IT FOR SALE, OR REPRODUCING IT, OR IMPORTING IT, OR EXPORTING IT, CONDITIONING IT FOR PROPAGATION, OR STOCKING IT FOR ANY OF THE ABOVE PURPOSE , OR USING IT IN UCING A HYBRID OR DIFFERENT VARIETY THEREFROM, TO THE EXTENT PROVIDED BY THE PLANT VARIETY CTION ACT. IN THE UNITED STATES SEED OF THIS VARIETY (1) SHALL BE SOLD BY VARIETY NAME ONLY AS A ERTIFIED SEED AND (2) SHALL CONFORM TO THE NUMBER OF GENERATIONS SPECIFIED BY THE OWNER OF 4 STAT. 1542, AS AMENDED, 7 U.S.C. 2321 ET SEQ.)

ALFALFA

'UC-Impalo-WF'

In Testimony Whereof, I have hereunto set my hand and caused the seal of the Plant Variety Protection Office to be affixed at the City of Washington, D.C. this tenth day of June, in the year two thousand two.

Attest:

Commissioner
Plant Variety Protection Office
Agricultural Marketing Service

Secretary of Agriculture

REPRODUCE LOCALLY, *Include form number and date on all reproductions*

Form Approved - OMB No. 0581-0055

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
SCIENCE AND TECHNOLOGY - PLANT VARIETY PROTECTION OFFICE

APPLICATION FOR PLANT VARIETY PROTECTION CERTIFICATE

(Instructions and information collection burden statement on reverse)

The following statements are made in accordance with the Privacy Act of 1974 (5 U.S.C 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF OWNER
The Regents of the University of California

2. TEMPORARY DESIGNATION OR EXPERIMENTAL NAME
UC-2598

3. VARIETY NAME
UC-Impalo-WF

4. ADDRESS *(Street and No., or R.F.D. No., City, State, and ZIP Code, and Country)*
1111 Franklin Street
12th Floor
Oakland, California 94607-5200

5. TELEPHONE *(include area code)*
510-587-6000

6. FAX *(include area code)*
510-587-6090

FOR OFFICIAL USE ONLY

~~PVPO NUMBER~~ Filing date
September 29, 2000

~~FILING DATE~~ PV Number
20000353

7. IF THE OWNER NAMED IS NOT A "PERSON", GIVE FORM OF ORGANIZATION *(corporation, partnership, association, etc.)*
Corporation

8. IF INCORPORATED, GIVE STATE OF INCORPORATION
California

9. DATE OF INCORPORATION
June 18, 1868

10. NAME AND ADDRESS OF OWNER REPRESENTATIVE(S) TO SERVE IN THIS APPLICATION. *(First person listed will receive all papers)*
Benton S. Duffett, Jr. and R. Danny Huntington
Burns, Doane, Swecker & Mathis, L.L.P.
P.O. Box 1404
Alexandria, VA 22313-1404

FEES RECEIVED

FILING AND EXAMINATION FEES:
$ 2450.00
9/29/00
DATE

CERTIFICATION FEE:
$ 320.00
DATE 3/12/02

11. TELEPHONE *(Include area code)*
703-838-6602

12. FAX *(Include area code)*
703-836-2021

13. E-MAIL
bend@burnsdoane.com

14. CROP KIND *(Common Name)*
Alfalfa

18. CHECK APPROPRIATE BOX FOR EACH ATTACHMENT SUBMITTED (Follow instructions on reverse)

- [X] a. Exhibit A. Origin and Breeding History of the Variety
- [X] b. Exhibit B. Statement of Distinctness
- [X] c. Exhibit C. Objective Description of Variety
- [X] d. Exhibit D. Additional Description of the Variety *(Optional)*
- [X] e. Exhibit E. Statement of the Basis of the Owner's Ownership
- [X] f. Voucher Sample *(2,500 viable untreated seeds or, for tuber propagated varieties, verification that tissue culture will be deposited and maintained in an approved public repository)*
- [X] g. Filing and Examination Fee ($2,450), made payable to "Treasurer of the United States" *(Mail to the Plant Variety Protection Office)*

19. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE SOLD AS A CLASS OF CERTIFIED SEED? *See Section 83(a) of the Plant Variety Protection Act)*
[X] YES *(If "yes", answer items 20 and 21 below)* [ ] NO *(If "no," go to item 22)*

20. DOES THE OWNER SPECIFY THAT SEED OF THIS VARIETY BE LIMITED AS TO NUMBER OF CLASSES? [X] YES [ ] NO
IF YES, WHICH CLASSES? [X] FOUNDATION [ ] REGISTERED [X] CERTIFIED

21. DOES THE OWNER SPECIFY THAT THE CLASSES BE LIMITED AS TO NUMBER OF GENERATIONS? [X] YES [ ] NO
IF YES, SPECIFY THE NUMBER 1, 2, 3, etc. [3] FOUNDATION [ ] REGISTERED [3] CERTIFIED
(If additional explanation is necessary, please use the space indicated on the reverse.)

22. HAS THE VARIETY (INCLUDING ANY HARVESTED MATERIAL) OR A HYBRID PRODUCED FROM THIS VARIETY BEEN SOLD, DISPOSED OF, TRANSFERRED, OR USED IN THE U. S. OR OTHER COUNTRIES?
YES NO X
IF YES, YOU MUST PROVIDE THE DATE OF FIRST SALE, DISPOSITION, TRANSFER, OR USE FOR EACH COUNTRY AND THE CIRCUMSTANCES. *(Please use space indicated on reverse.)*

23. IS THE VARIETY OR ANY COMPONENT OF THE VARIETY PROTECTED BY INTELLECTUAL PROPERTY RIGHT *(PLANT BREEDER'S RIGHT OR PATENT)*?
[ ] YES [X] NO
IF YES, GIVE COUNTRY, DATE OF FILING OR ISSUANCE AND ASSIGNED REFERENCE NUMBER. *(Please use space indicated on reverse.)*

24. The owners declare that a viable sample of basic seed of the variety will be furnished with application and will be replenished upon request in accordance with such regulations as may be applicable, or for a tuber propagated variety a tissue culture will be deposited in a public repository and maintained for the duration of the certificate.

The undersigned owner(s) is(are) the owner of this sexually reproduced or tuber propagated plant variety, and believe(s) that the variety is new, distinct, uniform, and stable as required in Section 42, and is entitled to protection under the provisions of Section 42 of the Plant Variety Protection Act.

Owner(s) is(are) informed that false representation herein can jeopardize protection and result in penalties:

SIGNATURE OF OWNER
X Linda S Stevenson

NAME *(Please print or type)*
Linda S. Stevenson

CAPACITY OR TITLE
Manager, Patent Prosecution

DATE
X 9/28/00

SIGNATURE OF OWNER

NAME *(Please print or type)*

CAPACITY OR TITLE

DATE

INSTRUCTIONS

200000353

GENERAL: To be effectively filed with the Plant Variety Protection Office (PVPO), ALL of the following items must be received in the PVPO: (1) Completed application form signed by the owner; (2) completed exhibits A, B, C, E; (3) for a seed reproduced variety at least 2,500 viable untreated seeds, for a hybrid variety at least 2,500 untreated seeds of each line necessary to reproduce the variety, or for tuber reproduced varieties verification that a viable *(in the sense that it will reproduce an entire plant)* tissue culture will be deposited and maintained in an approved public repository; (4) check drawn on a U.S. bank for $2,450 ($300 filing fee and $2,150 examination fee), payable to "Treasurer of the United States" *(See Section 97.6 of the Regulations and Rules of Practice.)* Partial applications will be held in the PVPO for not more than 90 days, then returned to the applicant as unfiled. Mail application and other requirements to Plant Variety Protection Office, AMS, USDA, Room 500, NAL Building, 10301 Baltimore Avenue, Beltsville, MD 20705-2351. Retain one copy for your files. All items on the face of the application are self explanatory unless noted below. Corrections on the application form and exhibits must be initialed and dated. DO NOT use masking materials to make corrections. If a certificate is allowed, you will be requested to send a check payable to "Treasurer of the United States" in the amount of $300 for issuance of the certificate. Certificates will be issued to owner, not licensee or agent.

Plant Variety Protection Office
Telephone: (301) 504-5518
FAX: (301) 504-5291
Homepage: http://www.ams.usda.gov/science/pvp.htm

ITEM

18a. Give:
(1) the genealogy, including public and commercial varieties, lines, or clones used, and the breeding method;
(2) the details of subsequent stages of selection and multiplication;
(3) evidence of uniformity and stability; and
(4) the type and frequency of variants during reproduction and multiplication and state how these variants may be identified

18b. Give a summary of the variety's distinctness. Clearly state how this application variety may be distinguished from all other varieties in the same crop. If the new variety is most similar to one variety or a group of related varieties:

(1) identify these varieties and state all differences objectively;
(2) attach statistical data for characters expressed numerically and demonstrate that these are clear differences; and
(3) submit, if helpful, seed and plant specimens or photographs (prints) of seed and plant comparisons which clearly indicate distinctness

18c. Exhibit C forms are available from the PVPO Office for most crops; specify crop kind. Fill in Exhibit C (Objective Description of Variety) form as completely as possible to describe your variety.

18d. Optional additional characteristics and/or photographs. Describe any additional characteristics that cannot be accurately conveyed in Exhibit C. Use comparative varieties as is necessary to reveal more accurately the characteristics that are difficult to describe, such as plant habit, plant color, disease resistance, *etc.*

18e. Section 52(5) of the Act requires applicants to furnish a statement of the basis of the applicant's ownership. An Exhibit E form is available from the PVPO.

19. If "Yes" is specified *(seed of this variety be sold by variety name only, as a class of certified seed)*, the applicant MAY NOT reverse this affirmative decision after the variety has been sold and so labeled, the decision published, or the certificate issued. However, if "No" has been specified, the applicant may change the choice. *(See Regulations and Rules of Practice, Section 97.103).*

22. *See Sections 41, 42, and 43 of the Act and Section 97.5 of the regulations for eligibility requirements.*

23. *See Section 5.5 of the Act for instructions on claiming the benefit of an earlier filing date.*

22. CONTINUED FROM FRONT *(Please provide the date of first sale, disposition, transfer, or use for each country and the circumstances, if the variety (including any harvested material) or a hybrid produced from this variety has been sold, disposed of, transferred, or used in the U.S. or other countries.)*

23. CONTINUED FROM FRONT *(Please give the country, date of filing or issuance, and assigned reference number, if the variety or any component of the variety is protected by intellectual property right (Plant Breeder's Right or Patent).)*

NOTES: It is the responsibility of the applicant/owner to keep the PVPO informed of any changes of address or change of ownership or assignment or owner's representative during the life of the application/certificate. There is no charge for filing a change of address. The fee for filing a change of ownership or assignment or any modification of owner's name is specified in Section 97.175 of the regulations. *(See Section 101 of the Act, and Sections 97.130, 97.131, 97.175(h) of the Regulations and Rules of Practice.)*

To avoid conflict with other variety names in use, the applicant must check the variety names proposed by contacting: Seed Branch, AMS, USDA, Room 213, Building 306, Beltsville Agricultural Research Center–East, Beltsville, MD 20705. Telephone: (301) 504-8089.

STD-470 (6-98) designed by the Plant Variety Protection Office with WordPerfect 6.0a. Replaces STD-470 (03-96) which is obsolete.

Exhibit A. Origin and breeding History of the variety:

Parent material for 'UC-Impalo-WF' was UC-356 a breeding mixture composed of 346 plants from 9 different UC breeding pools (UC-127, 7%; UC-295, 4%; UC-329, 15%, UC-330, 15%, UC-332, 19%; UC-340, 15%; UC-342, 17%; UC-344, <1%; and UC-346, 8%). Selected plants were placed in an isolated crossing block at the Desert Research and Extension Center in 1989 and seed harvested from individual plants in 1990. Half-sib families of each of the component plants were planted in four replicates in the spring of 1991. In October 1992, Seventy-six plants were selected for resistance to the Silverleaf Whitefly (*Bemisia argentifolii* Bellows and Perring) from a nursery of approximately 15,000 plants. Between 1993 and 1996 three additional cycles of selection were completed for resistance to the silverleaf whitefly and for increased seed production. Selection for resistance was practiced using "among and within half-sib family selection" in field nurseries at the Desert Research and Extension Center. In each cycle of selection 250 to 300 families were screened in replicated nurseries and the best 200 to 300 individuals selected from the top 15 to 21 families. Selected individuals were taken to Chile for seed production and low intensity screening for seed production. Seed from the selected individuals and selected elite families was used to construct the next years breeding nursery. Pre-breeder seed (UC-2458, syn-1) was produced in Chile and harvested in March 1997 from 186 plants selected in September 1996 at DREC. Breeder seed (UC-2531) was produced in March 1998 in Chile from UC-2458. Foundation generation seed was produced at the Kearney Research and Extension Center (Parlier, CA) in September 1998 (UC-2598), and Certified generation seed was harvested in March 1999 in Chile and September 1999 in Brawley, CA (UC-2681, syn-4). These seed lots were used to produce the documentation in this application.

Evidence of Uniformity and Stability:

This cultivar is a population developed from breeding lines in the University of California non-dormant alfalfa breeding program. All generations (Breeder, Foundation, and Certified) of UC-Impalo-WF have been tested under field research conditions at 5 locations in California and Arizona. The certified generation (to be sold as UC-Impalo-WF has also been tested on 14 sites composing approximately 600 acres in the primary area of adaptation (Imperial County California). All three generations (Breeder[Syn 2], Foundation[Syn 3], Certified[Syn 4]) of UC-Impalo-WF are uniform and stable in all tests.

The type and frequency of variants during reproduction and multiplication and how these variants may be identified.

UC-Impalo-WF is a broad based uniformly reproducing cross-pollinated population. Flower color is predominantly purple (98%) with a low frequency of variegated ($\leq$ 1%) and cream ($\leq$ 1%) flower color types. All flower color types can be assessed according to the standard protocol described by Barnes, D. K. 1972. A System for Visually Classifying Alfalfa Flower Color. Agriculture Handbook No. 424. 18pp.

An electronic copy of this publication can be obtained at:
http://www.naaic.org/Resources/colorguide/flowercolor.html

Exhibit B – Statement of Distinctness

'UC-Impalo-WF' is a very non-dormant cultivar (Fall Dormancy Rating (FDR) = 8.9) most similar to the University of California cultivar 'CUF 101'(FDR=8.9). It was developed entirely from genetic materials in the University of California non-dormant alfalfa breeding program. It is adapted to the low desert irrigated agricultural production areas of Southeastern California and Southwestern Arizona. UC-Impalo-WF is highly resistant to Fusarium wilt (*Fusarium oxysporum*) and spotted alfalfa aphid (*Threioaphis maculata*). It is resistant to Phytophthora root rot (*Phytophthora megasperma*), blue alfalfa aphid (*Acyrthosiphon kondoi*), pea aphid (*Acyrthosiphon pisum*), and southern root knot nematode (*Meloidogyne incognita*), and the silverleaf whitefly (*Bemisia argentifolii*). It is the first alfalfa cultivar with significant resistance to the silverleaf whitefly (Table 1)[1]. It is moderately resistant to bacterial wilt (*Clavibactor insidiosum*) and has low resitance to southern anthracnose (*Colletotrichum trifolii*) (Race 1). Resistance of this cultivar to Verticillium wilt (*Verticillium albo-atrum*) and Aphanomyces root rot (Race 1) (*Aphanomyces euteiches*) is unknown.

The relative resistance ratings of other cultivars for commonly occuring pests and diseases are presented in table 2. These ratings are those published by the Certified Alfalfa Seed Council 1999-2000. Except for the Silverleaf whitefly ratings and Values for UC-Impalo-WF.

Table 1. Silverleaf whitefly resistance of UC-Impalo-WF and other non-dormant alfalfa cultivars including the most similar cultivar, CUF 101.

Cultivar	Silverleaf whitefly index	Significance grouping	Cultivar description
CUF101	3.99	b	Public cultivar
WL 711wf	3.92	b	Private cultivar
UC-Cibola	3.89	b	Public cultivar
WL 525HQ	3.89	b	Private cultivar
UC-WF-4	3.87	b	susceptible check
Highline	3.67	b	Public cultivar
WL612	3.69	b	Private cultivar
UC-Impalo-WF	**3.23**	**a**	**This Cultivar**
$LSD_{0.05}$	0.39		
CV (%)	7.85		

[1] Resistance ratings for the Sileverleaf whitefly were determined according to standard procedures of the North American Alfalfa Improvement Conference (2000) procedures attached to this application. LSD is a Fishers Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

Table 2. Pest and Disease resistance ratings resistance ratings[1] of cultivars, including the most similar cultivar, CUF 101, adapted to production in the same area as UC-Impalo-WF.

Variety	Contact for marketing information	FD	Bw	Vw	Fw	An	PRR	SAA	PA	BAA	SN	RKN	Silverleaf Whitefly SLW
5715	Pioneer	8	LR	LR	HR	HR	R	HR	HR	HR	S	R	
5888	Pioneer	8			HR		R	HR	R	R	R		
5925	Pioneer	9			HR		R	R	HR	HR			
13R Supreme	ABI	8	MR	MR	R	MR	R		R				
Condor	Northrup King	8			HR		HR	HR	HR	HR			
CUF101	**Public**	**6**			**HR**		**MR**	**HR**	**HR**	**HR**	**LR**	**MR**	**S**
Falcon	Lohse Mill	8	LR		HR		MR	MR	MR	MR			
Highline	**Public**	**9**	**S**		**HR**	**S**	**R**	**HR**	**HR**	**R**		**HR**	**S**
Maricopa	Plant Gentics	8	MR	MR	HR	LR	R	HR	HR	R	R	HR	
Mecca	Plant Gentics	9	LR		HR	LR	MR	HR	HR	MR	MR	H	
Moapa 69	Public	8			HR			R	R			MR	
Sundor	Northrup King	9			HR		MR	HR	HR	HR	HR		
SW 8210	S & W Seed	8		MR	HR	MR	HR	HR	MR	HR	MR	R	S
UC Cibola	**Public**	**9**			**HR**		**MR**	**HR**	**HR**	**LR**		**R**	**S**
UC-Impalo-WF	**Public**	**9**	**LR**		**HR**	**MR**	**R**	**HR**	**R**	**R**		**R**	**R**
WL 516	W-L Research	8	MR		HR	LR	HR	HR	HR	HR	MR		
WL 525 HQ	W-L Research	8	MR		HR		HR	HR	HR	HR	R	HR	S
WL 605	W-L Research	9			HR	LR	HR	HR	HR	HR	MR		
WL 612	W-L Research	9			HR	LR	HR	HR	HR	HR	R	MR	S
WL 711 WF	W-L Research	10			HR		R	R	HR	HR	R	HR	S

[1] BW=Bacterial Wilt, VW=Verticillium Wilt, FW= Fusarium Wilt, AN=Southern Anthracnose, PRR=Phytophthora Root Rot, SAA=Spotted Alflafa Aphid, PA=Pea Aphid, BAA=Blue Alfalfa Aphid, SN=Stem Nematode, NRKN=Northern Root Knot Nematode, SRKN=Southern Root Knot Nematode.

UC-Impalo-WF differs from the most similar cultivar, CUF 101, as follows (Table 3).

UC-Impalo-WF is higher in resistance to Bacterial Wilt and Spotted Alfalfa Aphid than CUF 101. CUF 101 is susceptible to the Silverleaf Whitefly (Figure 1, Exhibit C). Across all test locations (5) forage yield of UC-Impalo-WF was 101% of CUF 101.

6

Table 3. Pest and Disease resistance ratings of UC-Impalo-WF and the comparison (most similar) University of California alfalfa cultivar CUF-101 (Refer to Exhibit B for specific test results).

TEST	UCID No.	Pedigree	Yield across all test locations (%)	Yield in area of adaptation (%)	FD	BW	VW	FW	AN	PRR	SAA	PA	BAA	SN	NRKN	SRKN	SLWF sticky	SLWF immature
1	UC-101	CUF 101			8.8						60	55	55				3.69	4.10
2	UC-101	CUF 101			9.0						60	55	55				4.09	4.35
Average CUF101	UC-101	CUF 101	100	100	8.9						60	55	55				3.89	4.23
1	UC-2598	UC-Impalo-WF			8.8						77	49	55				3.17	3.29
2	UC-2598	UC-Impalo-WF			9.1						82	47	50				3.13	3.28
Average UC-Impalo-WF	UC-2598	UC-Impalo-WF	101	101	8.9						79	48	52				3.15	3.29
	Impalo vs CUF 101		**+1**	**+1**	**0.0**						**+19**	-7	-3				**-0.74**	**-0.94**
	Percentage difference		**+1**	**+1**	**0.0**						**+19**	-7	-3				**-81**	**-77**

FD=Fall Dormancy, BW=Bacterial Wilt, VW=Verticillium Wilt, FW= Fusarium Wilt, AN=Southern Anthracnose, PRR=Phytophthora Root Rot, SAA=Spotted Alfalfa Aphid, PA=Pea Aphid, BAA=Blue Alfalfa Aphid, SN=Stem Nematode, NRKN=Northern Root Knot Nematode, SRKN=Southern Root Knot Nematode, SLWF=Silverleaf Whitefly. S=susceptible, 0 to 5%; LR=low resistance, 6 to 14%; MR=moderate resistance, 15 to 30%; R=resistant, 31 to 50%; and HR=high resistance, >50%.

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
SCIENCE AND TECHNOLOGY
PLANT VARIETY PROTECTION OFFICE
BELTSVILLE, MD 20705

EXHIBIT C
(Alfalfa)

OBJECTIVE DESCRIPTION OF VARIETY
ALFALFA (*Medicago sativa, sensu* Gunn *et al.*)

NAME OF APPLICANT(S)
The Regents of the University of California

ADDRESS (*Street and No. or RD No., City, State, and Zip Code*)
1111 Franklin Street
12th Floor
Oakland, California 94607-5200

FOR OFFICIAL USE ONLY

PVPO NUMBER
200000353

VARIETY NAME
UC-Impalo-WF

TEMPORARY OR EXPERIMENTAL DESIGNATION
UC-2598

PLEASE READ ALL INSTRUCTIONS CAREFULLY: Place the appropriate number that describes the varietal character of this variety in the boxes below. Place a zero in the first box (e.g. or) when number is either 99 or less or 9 or less respectively. Data for quantitative plant characters should be based on a minimum of 100 plants. Comparative data should be determined from varieties entered in the same trial. Royal Horticultural Society or any recognized color standard may be used to determine plant colors; designate system used: Munsel plant tissue color chart, pantone color specifier

Please answer all questions for your variety; lack of response may delay progress of your application.

1. FALL DORMANCY: (DETERMINED FROM SPACED PLANTINGS)

TESTING INSTITUTION AND LOCATION		DATE OF LAST CUT	DATE REGROWTH SCORED	REGROWTH SCORE OR AVERAGE HEIGHT						
				APPLICATION VARIETY	CHECK VARIETIES*					
					CUF101	Pierce	Mesilla	LSD .05	CV	$\bar{X}$
UC Davis	Tulelake, CA	9/7/99	10/1/99	2.70	2.80	2.65	2.38	0.125	3.68	2.45
	UC Davis, CA	10/4/99	10/29/99	2.96	2.96	2.89	2.65	0.123	3.36	2.65
	Imperial, CA	10/22/99	11/15/99	2.32	2.30	2.14	1.94	0.210	7.46	2.06
					UC-1887	CUF101	Pierce			
UC Davis	Tulelake, CA	9/7/99	10/1/99		2.85	2.80	2.65	0.125	3.68	2.45
	UC Davis, CA	10/4/99	10/29/99		3.22	2.96	2.89	0.123	3.36	2.65
	Imperial, CA	10/22/99	11/15/99		2.42	2.30	2.14	0.210	7.46	2.06

(* The varieties in parentheses are acceptable check varieties; application varieties must be bracketed by check varieties)

CLASS

[1]

1 = Very Non-Dormant ('CUF 101', 'Mecca', '5929')
2 = Non-Dormant ('Moapa 69', '5715', 'Pierce')
3 = Non-Dormant ('Mesilla', 'Sutter', 'Malone')
4 = Moderately Dormant ('Lahontan', '581', 'Express')
5 = Moderately Dormant ('Excalibur', 'Du Puits', '555')
6 = Moderately Dormant ('Saranac', 'WL 316', 'Legend')
7 = Dormant ('Ranger', 'Arrow', 'WL 317')
8 = Dormant ('Vernal', '526', 'Wrangler')
9 = Very Dormant ('Norseman', '5151', 'Spredor 2')

Specify scoring system used: Standard test to Characterize Alfalfa Cultivars, Third Edition revised August 1998. LSD is a Fisher Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

1. FALL DORMANCY: (continued)

FALL GROWTH HABIT (Determined from Fall Dormancy Trials)

[1]

1 = Erect ('CUF 101')
3 = Semi-Erect ('Mesilla')
5 = Intermediate ('Saranac AR')
7 = Semi-Decumbent ('Vernal')
9 = Decumbent ('Norseman').

---

2. RECOVERY AFTER FIRST SPRING CUT (In Southwest, first cut after March 21):

[1]

1=Very fast ('CUF 101') 3= Fast ('Mesilla') 5=Intermediate ('Ranger') 7=Slow ('Vernal') 9=Very slow ('Norseman')

TEST LOCATION: Desert Research and Extension Center and Imperial County

---

3. AREAS OF ADAPTATION IN U.S. :

Describe the area for which this variety is adapted; that is, define geographically, or in terms of climate and soils, the region(s) n which it may reasonably be expected to perform well.

THIS CHARACTERIZATION MUST BE SUPPORTED BY TEST LOCATIONS AND DATA ON PERSISTENCE.

This cultivar is adapted to arid irrigated agricultural production regions of Southern California and Southwestern Arizona (principally the Imperial, Palo Verde, and Yuma Valleys).

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4. FLOWERING DATE (When 10% of plants possesses open flowers at time of first spring cut):

[0][4]

Days earlier than ..... [ ]

..... Same as ..... [ ]

Days later than ..... [1]

Please make all 3 comparisons if possible.

1='CUF 101' 2='Mesilla' 3='Saranac'
4='Vernal' 5='Norseman'

Test location Desert Research and Extension Center

Cut 2/4/00 score late March 2000

---

5. PLANT COLOR (Determined from healthy regrowth 3 weeks after first spring cut, controlling leafhoppers if necessary):

[2]

1= Very Dark Green ('524') 2=Dark Green ('Vernal') 3=Light Green ('Ranger')

Color Chart Value (specify chart used) Pantone 747XR; Munsel Plant Tissue Color Chart 7.5GY

Application Variety 371U; 7.5GY 4-2

Vernal 378U; 7.5GY 4-2

Test Location Davis, CA; El Centro, CA

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6. CROWN TYPE (Determined from spaced plants):

[3]

Non-creeping types 1=Broad ('Vernal') 2=Intermediate ('Saranac AR') 3=Narrow ('CUF 101')

Creeping types 4=Creeping rooted ('Rangelander') 5=Rhizomatous ('Rhizoma')

7. **FLOWER COLOR** (Determine frequency of plants for each color class as defined by USDA Agricultural Handbook No. 424 (Barnes 1972), allowing all plants in plot to flower):

	9	8	% Purple and Violet (Subclasses 1.1 to 1.4)
	≤	1	% Variegated (Subclasses 2.1 to 2.9)
	≤	1	% Cream (Class 3)

		0	% Yellow (Subclasses 4.1 to 4.4)
		0	% White (Class 5)

Test Location :

8. **POD SHAPE** (Determine frequency of plants with the following pod shapes produced on well cross-pollinated racemes):

1	0	0	% Tightly coiled (one or more coils, center more or less closed).
			% Loosely coiled (one or more coils, center conspicuously open).
			% Sickle (less than one coil).

Test location : West Side Research & Extension Center, Five Points, CA; Desert Research & Extension Center, El Centro, CA

9. **PEST AND DISEASE RESISTANCE:** Provide in the appropriate space, trial data for application variety and appropriate resistant (R) and susceptible (S) check varieties, resistance class, year tested, synthetic generation tested, number of plants tested, least significant difference statistics (LSD .05), coefficient of variance (CV), experimental mean ($\bar{x}$), the institution in charge of test, and location of test, and whether test is a field or laboratory evaluation. Data must be from tests conducted by private firms, agricultural experiment stations or USDA. Describe scoring system and any test procedure which differs from those approved by the NAAIC. Resistance levels should be characterized using % resistant plants as follows: S= <6%, LR=6-14%, MR=15-30%, R=31-50%, HR= >50%. Checks should be based on long term resistance averages as approved by the NAAIC. Data must be adjusted to the long term mean of the resistant check variety. Supply both adjusted and unadjusted values. Trial data from other test years or locations should be presented whenever available on a separate document as Exhibit D. Seeds of the check varieties and germplasm lines below can be obtained from the USDA Soybean & Alfalfa Research Laboratory, Bldg. 002, Rm. 10, BARC-West, Beltsville, MD, 20705. Comparison is required with check varieties listed below; data must be adjusted according to the expected value of the resistant check. State who made the adjustment.

A. DISEASE RESISTANCE:

ANTHRACNOSE (Race 1) *(Colletotrichum trifolii)*

Test conducted by Crop Characteristics at Farmington, MN

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
Test #1					
This Variety 1. 'Arc' or 2. 'Saranac AR' 3. 'Saranac'	LR HR 65% R 45% S 1%	Syn-3 (Foundation)	10 69 48 3.0	9.0 65.0 45 3.0	170 to 180 170 to 180 170 to 180 170 to 180
L.S.D. (.05) C.V. (%) $\bar{X}$			7.2 14.5 35.3	7.3 18.5 27.8	
Test #2					
This Variety 1. 'Arc' or 2. 'Saranac AR' 3. 'Saranac'	LR HR 65% R 45% S 1%	Syn-4 (Certified)	12.8 72.8 40.3 1.8	11.4 65.0 35.9 1.6	180 180 180 180
L.S.D. (.05) C.V. (%) $\bar{X}$			7.2 14.5 35.3	6.4 14.5 31.5	

Field or Laboratory/ Year Tested Laboratory; (Test1 / Test 2): January 1999 / March 2000

Scoring system used Percentage survival, Standard Tests to Characterize Alfalfa Cultivars, Third Edition ; LSD is a Fishers Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

ANTHRACNOSE (Race 2) *(Colletotrichum trifolii)*

Test conducted by No claim at

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety 1. 'Saranac AR' 2. 'Arc' or 3. 'Saranac'	R 45% S S				
L.S.D. (.05) C.V. (%) $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

APHANOMYCES ROOT ROT (Race 1) *(Aphanomyces euteiches)*

Test conducted by No Claim **at**

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety 1. 'WAPH-1' 2. 'Agate'	R 50% S 1%				
L.S.D. (.05) C.V. (%) $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

APHANOMYCES ROOT ROT (Race 2) *(Aphanomyces euteiches)*

Test conducted by No Claim **at**

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety 1. 'WAPH-1' 2. 'Agate'	R 50% S 1%				
L.S.D. (.05) C.V. (%) $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

BACTERIAL WILT ***(Clavibacter michiganense)***

Test conducted by Crop Characteristics **at** Farmington, MN

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
Test #1					
This Variety **1. 'Vernal'** **2. 'Narragansett'** **3. or 'Sonora'**	**MR** **R 42%** **S 1%** **S 1%**	Syn-3 (Foundation)	22 49 3 2	19 42 2 2	152 153 149 142
L.S.D. (.05) **C.V. (%)** $\bar{X}$			11.1 18.4 43.0	9.5 18.4 36.9	
Test #2					
This Variety **1. 'Vernal'** **2. 'Narragansett'** **3. or 'Sonora'**	**MR** **R 42%** **S 1%** **S 1%**	Syn-4 (Foundation)	22 49 3.3 3.0	19 42 3.6 3.3	117 123 139 122
L.S.D. (.05) **C.V. (%)** $\bar{X}$			12.2 23.2 37.5	13.4 23.2 41.3	

Field or Laboratory/ Year Tested Field; (Test 1 / Test 2): September 1999 / September 2000

Scoring system used 5 Classes; Class 0 & 1 resistant; Standard Tests to Characterize Alfalfa Cultivars, Third Edition ; LSD is a Fishers Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

COMMON LEAFSPOT ***(Pseudopeziza medicaginis)***

Test conducted by No Claim **at**

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety **1. 'MSA-CW3ANS3'** **2. or 'Ramsey'** **3. 'Ranger'** **4. 'Moapa 69'**	**HR 60%** **HR 60%** **MR 30%** **S 0-10%**				
L.S.D. (.05) **C.V. (%)** $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

12

DOWNY MILDEW ***(Peronospora trifoliorum)***

Isolate , if known

Test conducted by No Claim **at**

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety **1. 'KS208'** **2. 'Saranac'** **isolates 15 & 17** **isolate 18** **3. 'Kanza'**	**HR 80%** **MR 15-20%** **R 50-60%** **S 0- 5%**				
L.S.D. (.05) **C.V. (%)** $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

Exhibit C ***(Alfalfa)***

FUSARIUM WILT ***(Fusarium oxysporum* f. *medicaginis)***

Test conducted by Crop Characteristics **at** Farmington, MN

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
Test #1					
This Variety **1. 'Agate'** **2. 'MNGN-1'**	**HR** **HR 54%** **S**	Syn-3 (Foundation)	63 60 6	57 54 5	148 154 156
L.S.D. (.05) **C.V. (%)** $\bar{X}$			10.9 14.7 52.5	9.8 14.7 47.2	
Test #2					
This Variety **1. 'Agate'** **2. 'MNGN-1'**	**HR** **HR 54%** **S**	Syn-4 (Certified)	50.4 49.8 7.2	54.6 54.0 7.8	148 145 147
L.S.D. (.05) **C.V. (%)** $\bar{X}$			10.9 14.7 52.5	9.8 14.7 47.2	

Field or Laboratory/ Year Tested Laboratory; (Test 1 / Test 2): September 1999 / September 2000

Scoring system used 6 Classes; Class 0 & 1 resistant; Standard Tests to Characterize Alfalfa Cultivars, Third Edition; LSD is a Fishers Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

PHYTOPHTHORA ROOT ROT *(Phytophthora megasperma* f. *medicaginis)*

Test conducted by Crop Characteristics **at** Farmington, MN

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
Test #1					
This Variety **1. 'Agate'** **2. 'Saranac'**	**R** **R 43%** **S 3%**	Syn-3 (Foundation)	29.0 38.0 4.0	33.0 43.0 4.0	160 160 160
L.S.D. (.05) **C.V. (%)** $\bar{X}$			12.0 23.4 35.8	13.6 23.4 40.5	
Test #2					
This Variety **1. 'Agate'** **2. 'Saranac'**	**R** **R 43%** **S 3%**	Syn-4 (Certified)	35.6 43.8 6.5	35.0 43.0 6.4	160 158 111
L.S.D. (.05) **C.V. (%)** $\bar{X}$			7.7 18.0 30.2	7.6 18.0 29.6	

Field or Laboratory/ Year Tested Lab test; (Test 1 / Test 2): January 1999 / June 2000

Scoring system used 6 Class System, Class 1 & 2 resistant; Standard Tests to Characterize Alfalfa Cultivars, Third Edition ; LSD is a Fishers Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

VERTICILLIUM WILT *(Verticillium albo-atrum)*

Test conducted by No Claim **at**

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety **1. 'Vertus' or** **2. 'Oneida VR'** **3. 'Saranac'**	**R 40%** **HR 60%** **S 2%**				
L.S.D. (.05) **C.V. (%)** $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

OTHER (SPECIFY)

Test conducted by **at**

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety 1. 2. 3.	 S				
L.S.D. (.05) C.V. (%) $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

B. INSECT RESISTANCE:

BLUE ALFALFA APHID *(Acyrthosiphon kondoi)*

Test conducted by Crop Characteristics **at** Farmington, MN

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
Test #1					
This Variety 1. 'CUF 101' 2. 'PA-1' or 3. 'Caliverde'	HR HR 55% S 10% S 3%	Syn-3 (Foundation)	54.2 54.0 14.5 3.9	55.2 55.0 14.8 4.0	179 165 173 179
L.S.D. (.05) C.V. (%) $\bar{X}$			8.0 18.7 30.4	8.2 18.7 30.9	
Test #2					
This Variety 1. 'CUF 101' 2. 'PA-1' or 3. 'Caliverde'	R HR 55% S 10% S 3%	Syn-4 (Certified)	37.2 41.1 8.3 2.2	49.8 55.0 11.2 3.0	180 180 180 180
L.S.D. (.05) C.V. (%) $\bar{X}$			8.0 24.8 22.9	10.7 24.8 30.6	

Field or Laboratory/ Year Tested Laboratory; (Test 1 / Test 2): January 2000/ November 2000

Scoring system used 5 Classes, Class 1 & 2 resistant; Standard Tests to Characterize Alfalfa Cultivars, Third Edition; LSD is a Fishers Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

PEA APHID ***(Acyrthosiphon pisum)***

Test conducted by Crop Characteristics **at** Farmington, MN

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
Test #1					
This Variety **1. 'CUF 101' or** **2. 'PA-1' or** **3. 'Baker'** **4. 'Vernal' or** **5. 'Moapa 69'**	**R** **HR 55%** **HR 55% 45%** **R 5%** **S 5%** **S**	Syn-3 (Foundation)	40.0 45.0 41.0 ---- ---- 8.0	49.0 55.0 50.0 ---- ---- 10.0	167 154 121 ---- ---- 176
L.S.D. (.05) **C.V. (%)** $\bar{X}$			7.7 15.6 32.6	9.4 15.6 39.8	
Test #2					
This Variety **1. 'CUF 101' or** **2. 'PA-1' or** **3. 'Baker'** **4. 'Vernal' or** **5. 'Moapa 69'**	**R** **HR 55%** **HR 55% 45%** **R 5%** **S 5%** **S**	Syn-4 (Certified)	44.4 51.6 42.3 ---- ---- 6.1	47.4 55.0 45.1 ---- ---- 6.5	180 178 163 ---- ---- 180
L.S.D. (.05) **C.V. (%)** $\bar{X}$			8.3 16.2 33.4	8.8 16.2 35.6	

Field or Laboratory/ Year Tested Laboratory; (Test 1 / Test 2): January 1999 / March 2000

Scoring system used 5 Classes; Class 1 to 3 resistant; Standard Tests to Characterize Alfalfa Cultivars, Third Edition; LSD is a Fishers Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

SPOTTED ALFALFA APHID *(Therioaphis maculata)*

Test conducted by Crop Characteristics **at** Farmington, MN

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
Test #1					
This Variety **1. 'CUF 101' or** **2. 'Baker'** **3. 'Arc' or** **4. 'Caliverde'**	**HR** **HR 60%** **R 50%** **S 3%** **S 3%**	Syn-3 (Foundation)	77 60.0 ---- ---- 2.0	77 60.0 ---- ---- 2.0	180 179 ---- ---- 180
L.S.D. (.05) **C.V. (%)** $\bar{X}$			6.9 9.7 49.0	6.9 9.7 49.0	
Test #2					
This Variety **1. 'CUF 101' or** **2. 'Baker'** **3. 'Arc' or** **4. 'Caliverde'**	**HR** **HR 60%** **R 50%** **S 3%** **S 3%**	Syn-4 (Certified)	86 63.1 ---- 0.0	81.7 60.0 ---- 0.0	179 178 ---- 180
L.S.D. (.05) **C.V. (%)** $\bar{X}$			9.4 12.3 52.4	8.9 12.3 49.8	

Field or Laboratory/ Year Tested Laboratory; (Test 1 / Test 2): January 1999 / April 2001

Scoring system used 5 Classes, Classes 1 & 2 resistant; Standard Test Procedures to Characterize Alfalfa Cultivars, Third Edition; LSD is a Fishers Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

POTATO LEAFHOPPER YELLOWING *(Empoasca fabæ)*

Test conducted by No Claim **at**

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety **1. 'MSA-CW3AN3'** **2. 'Ranger'**	**R 70%** **S 5%**				
L.S.D. (.05) **C.V. (%)** $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

OTHER (SPECIFY) SILVER LEAF WHITEFLY (*Bermisia argentifolii)*

Test conducted by University of California at Desert Research and Extension Center, El Centro, CA

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Stickiness ASI	Immatures ASI	Number of Plants Tested
Test #1					
This Variety	**R**	Syn 3 (Foundation)	3.17	3.29	104
1.UC-2558	**R 2.2 / 2.0**		2.87	2.49	104
2. CUF 101	**S 3.9 / 3.9**		3.69	4.10	104
3. UC-WF-4	**S 3.8 / 4.1**		3.8	3.34	104
L.S.D. (.05)			0.34	0.52	
C.V. (%)			7.2	10.8	
$\bar{X}$			3.31	3.34	
Test #2					
This Variety	**R**	Syn 2 (Breeder)	3.13	3.28	110
1. UC-2558	**R 2.2 / 2.0**		2.47	2.28	105
2. CUF 101	**S 3.9 / 3.9**		4.09	4.35	104
3. UC-WF-4	**S 3.8 / 4.1**		4.20	4.36	100
4. UC-Cibola	**S**		4.01	4.17	105
5. Highline	**S**		3.8	3.85	104
L.S.D. (.05)			0.32	0.35	
C.V. (%)			11.0	13.2	
$\bar{X}$			3.54	3.87	

Field or Laboratory/ Year Tested Field; (Test 1 / Test 2) August 1999 / August 1998

Scoring system used 5 Classes, Classes 1 & 2 resistant; Standard Tests to Characterize Alfalfa Cultivars, Third Edition added July 2000 (protocol attached); LSD is a Fishers Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

C. NEMATODE RESISTANCE:

NORTHERN ROOT KNOT NEMATODE *(Meloidogyne hapla)*

Test conducted by _____ **at**

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety 1. 'Nevada Syn XX' 2. 'Lahontan'	 HR 90% S 3%				
L.S.D. (.05) C.V. (%) $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

SOUTHERN ROOT KNOT NEMATODE *(Meloidogyne incognita)*

Test conducted by Crop Characteristics **at** Farmington, MN

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
Test #1					
This Variety 1. 'Moapa 69' 2. 'Lahontan'	R R 50% S 3%	Syn-3 (Foundation)	55 56 0	49 50 0	170 169 164
L.S.D. (.05) C.V. (%) $\bar{X}$			12.8 18.8 47.4	11.4 18.8 42.3	
Test #2					
This Variety 1. 'Moapa 69' 2. 'Lahontan'	R R 50% S 3%	Syn-4 (Certified)	44.2 52.4 1.3	42.0 50 1.2	172 179 161
L.S.D. (.05) C.V. (%) $\bar{X}$			12.5 29.1 26.8	11.9 29.1 25.5	

Field or Laboratory/ Year Tested Laboratory; (Test 1 / Test 2): January / February 2000

Scoring system used Root galling 4 Classes, Class 1 resistant; Standard Tests to Characterize Alfalfa Cultivar Resistance, Third Edition; LSD is a Fishers Protected LSD based on an ANOVA that shows significant differences in the mean at $P\alpha \leq 0.05$.

STEM NEMATODE *(Ditylenchus dipsaci)*

Test conducted by No Claim at

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety 1. 'Vernema' or 2. 'Lahontan' 3. 'Ranger' or 4. 'Moapa 69' –	R 60% R 40% S 5% S 1%				
L.S.D. (.05) C.V. (%) $\bar{X}$					

Field or Laboratory/ Year Tested
Scoring system used

Exhibit C *(Alfalfa)*

OTHER (SPECIFY)

Test conducted by at

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety 1. 2. 3.	S				
L.S.D. (.05) C.V. (%) $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

OTHER (SPECIFY)

Test conducted by at

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety 1. 2. 3.	S				
L.S.D. (.05) C.V. (%) $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

20

OTHER (SPECIFY)

Test conducted by _____ **at**

Variety	Resistance Class/ Expected Value	Syn. Gen. Tested	Unadjusted % Resistance	Adjusted % Resistance	Number of Plants Tested
This Variety 1. 2. 3.	S				
L.S.D. (.05) C.V. (%) $\bar{X}$					

Field or Laboratory/ Year Tested

Scoring system used

Exhibit C: Objective Description of the Variety

Description of cultivar:

This cultivar is a broad based germplasm pool developed by four cycles of among and within half-sib family selection from within a breeding population designated UC-356. UC-356 was developed from nine different source pools in the University of California alfalfa breeding program. The component populations had previously been selected for resistance to saline soil conditions, root knot nematode (*Meloidogyne* sp.), Phytophthora root rot (*Phytophthora megasperma*), bacterial wilt (*Clavibactor insidiosum*), and Fusarium root rot (*Fusarium oxysporum*), blue alfalfa aphid (*Acyrthosiphon kondoi*), Pea aphid (*Acyrthosiphon pisum*), spotted alfalfa aphid (*Threioaphis maculata*), and forage yield and adaptation in the low desert production area of California and Arizona. This germplasm pool is composed of: 0%, *M. falcata*: 0%, Ladak; 1%, *M. varia*; 8%, Turkistan; 0%, Flemish; 7%, Chilean; 1%, Peruvian; 15%, Indian; 35%, African; 10%, Arabian; and 23%, unknown sources of germplasm.

This cultivar is adapted to Low Desert irrigated production areas. It has been tested in the Imperial and San Joaquin Valleys of California, and Central Arizona. It is intended for hay, haylage, greenchop, or dehydration. The target market area will be the Low Desert irrigated alfalfa production areas of California and Extreme South Western Arizona.

This cultivar is very nondormant (group 9) with a Fall Dormancy rating of 8.7 based on University of California Dormancy Trials, Flower color is predominantly purple (98%) with a trace of Variegated types (≤ 1%) and a trace of Cream (< 1%). Flower color data were determined on Syn. 4 (UC-2681).

It is highly resistant to Fusarium wilt (*Fusarium oxysporum*) and spotted alfalfa aphid (*Threioaphis maculata*). It is resistant to Phytophthora root rot (*Phytophthora megasperma*), blue alfalfa aphid (*Acyrthosiphon kondoi*), pea aphid (*Acyrthosiphon pisum*), and southern root knot nematode (*Meloidogyne incognita*), and the silverleaf whitefly (*Bemisia argentifolii*). It is moderately resistant to bacterial wilt (*Clavibactor insidiosum*) and has low resitance to southern anthracnose (*Colletotrichum trifolii*) (Race 1). Resistance of this cultivar to Verticillium wilt (*Verticillium albo-atrum*) and Aphanomyces root rot (Race 1) (*Aphanomyces euteiches*) is unknown. This cultivar is equal in yield to the Cultivars CUF 101 and Highline and is the first cultivar with substantial resistance to the Silverleaf Whitefly. It has been field tested by growers on over 500 acres in Imperial county and has been generated strong grower enthusiasm.

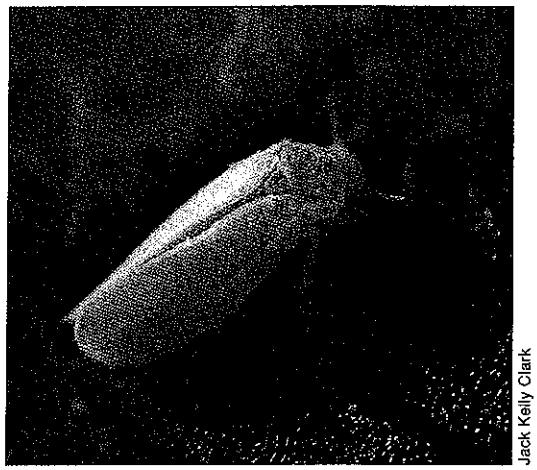
Seed classes of this cultivar will be Breeder (produced in a field isolation in 1998), Foundation and Certified. Breeder and Foundation seed classes will be maintained by the University of California Foundation Seed Project, Davis or its designee. Foundation and Certified seed production are each limited to a 3-year stand life. Seed production of both Foundation and Certified classes is limited to the San Joaquin Valley of California south of 37°25'N latitude and Riverside and Imperial counties of California south of 34°00'N latitude.

Certified seed will first be offered for sale in 2000.

Variety name: UC-Impalo-WF
Experimental Designations: UC-2458 (pre-breeder, Syn-1), UC-2531(breeder, Syn-2), UC-2598(foundation, Syn-3), UC-2681(certified, Syn-4)

Breeding resistant alfalfa holds promise for silverleaf whitefly management

Larry R. Teuber ❑ Michael E. Rupert ❑ Larry K. Gibbs
Ken L. Taggard



Jack Kelly Clark

From Fall 1991 to April 1994, silverleaf whitefly caused crop damage totaling $336 million in Imperial County alone.

Since 1991, the silverleaf whitefly has caused serious damage to alfalfa production in the southern desert region. Reports from the Imperial County Agricultural Commissioner suggest that direct and indirect effects of the whitefly have caused average forage yields to decrease by 17%. Recently developed plant-breeding procedures are proving successful in developing genetic resistance to this insect. We expect to have adapted cultivars with silverleaf whitefly resistance available to growers by 2000.

Franklin F. Laemmlen

Sooty mold spores that grow on alfalfa that is severely infested with the silverleaf whitefly create serious dust problems. Blackened with the mold, the bales are difficult to market.

Damage to U.S. crops from silverleaf whitefly *(Bemisia argentifolii* Bellows and Perring) was estimated at $200 million in 1991 and $500 million in 1992. Formerly known as "strain B" of the sweetpotato whitefly, *Bemisia tabaci* (Gennadius), the silverleaf whitefly (SLWF) is present in both the Low Desert (a geographic production area including the Coachella, Imperial, and Palo Verde valleys) and the Central Valley and threatens California agriculture and horticulture statewide. The SLWF is a devastating agricultural pest in California's Low Desert alfalfa production region. In Imperial County, alfalfa ranks second in gross agricultural earnings and occupies approximately one-third of all agricultural acreage. From the fall of 1991 to April 1994, crop damage caused by the SLWF totaled $336 million in Imperial County alone, and losses to Imperial County alfalfa producers were estimated to exceed $26 million per year.

The silverleaf whitefly is more damaging and, unfortunately, more difficult to control than other whitefly species. Factors contributing to the severity of damage are the SLWF's higher reproductive rate compared with other whitefly species, much wider host range, greater production of sticky honeydew exudate and its association with phytotoxic disorders in some plant species. Populations of this relatively new agricultural pest have demonstrated an astounding capacity to develop resistance to insecticides, an important consideration for plant breeders. In addition, there are no highly effective natural enemies of the SLWF.

There are no controlled experiments that clearly quantify SLWF damage to alfalfa in terms of yield or forage quality reduction. This is partly due to the inability to create an uninfested control. Grower records, Imperial County Agricultural Commissioner annual reports and UC forage-yield-trial records all strongly suggest, however, that the SLWF may directly or indirectly reduce alfalfa forage yield by 10 to 25%. Imperial County Agricultural Commissioner's reports since 1990 show a 17% reduction in annual alfalfa hay yield.

Lack of either resistant cultivars or chemical controls has prompted many

◀ **Numbers of immature whiteflies and stickiness caused by honeydew excretion are measured on scales of 1 to 5. A. For immature whitefly densities, 1 = no immature whiteflies and 5 = > 100 immature whiteflies/cm². B. For stickiness, 1 = clean and 5 = saturated quantities of honeydew.**

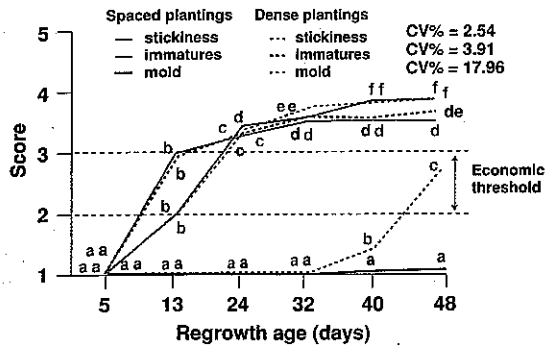


Fig. 1. Comparison of silverleaf whitefly infestation parameters measured in dense and spaced alfalfa plantings during July and August at the UC Desert Research & Extension Center. Regrowth ages on pairs of lines (e.g., stickiness) associated with same letter are not significantly different ($P \leq 0.05$, Fisher's Protected LSD).

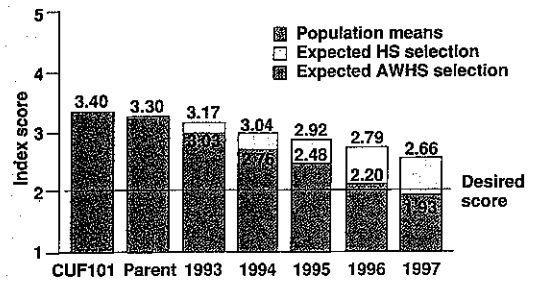


Fig. 2. Initial prediction of selection progress for silverleaf whitefly resistance using half-sib family selection (HS) and among-and-within half-sib family selection (AWHS), based on open-pollinated seed derived from half-sib families of UC-356.

growers to withhold all or part of the normal irrigation water for alfalfa during the late summer months to reduce production costs and reduce whitefly populations. Commonly referred to as "dry-down," this practice often results in serious stand loss. We have conducted studies with Frank Robinson to determine the feasibility and influence on stand and yield of summer dry-down management. These studies, however, have not identified management practices that eliminate the impact of the SLWF and avoid stand loss. Even if a dry-down management did exist, it would only avoid the problem of the SLWF by sacrificing additional hay production.

In addition to reducing yield, the SLWF can also reduce alfalfa quality. The insect's copious production of honeydew provides a substrate for the growth of a sooty mold fungus (*Capnodium* spp). Marketability of hay blackened by the growth of this sooty mold is drastically reduced. Also, honeydew makes the alfalfa foliage sticky, increasing the energy required for swathing and baling, which increases harvest costs.

Although alfalfa does not appear to be a primary host of the SLWF, it does occupy a very high percentage of agricultural land year-round in the Low Desert. As a result, alfalfa may provide a habitat and reservoir for large SLWF populations and serve as a source for infestation of other crops. Given the importance of alfalfa (and of the southern desert agricultural region) to the agricultural economy of California, the potential role of alfalfa in harboring whitefly populations, and the current lack of effective and economical pesticides or alternative cultural controls, the development of alfalfa cultivars with resistance to the SLWF is essential. Historically, breeding for insect and disease resistance has been particularly successful in alfalfa. More than 250 cultivars currently registered in the United States possess stable economic field resistance to a range of agricultural pests and diseases.

In October 1992, 73 alfalfa plants exhibiting apparent resistance to the SLWF were identified in the field at the UC Desert Research & Extension Center (DREC) in El Centro. These plants were taken from a study containing more than 10,000 plants in half-sib families (a group of plants that have the same female parent) composing the germplasm pool (genetically diverse population used in plant breeding) UC-356. Consistent identification of potentially resistant plants in half-sib families with reduced levels of infestation encouraged us that alfalfa cultivars could be developed with resistance to the SLWF. Our program to develop SLWF resistance has four primary objectives: 1) to devise a visual method of quantifying the level of whitefly infestation for use in assessing differences among genetic materials; 2) to develop baseline information on the development of SLWF populations in alfalfa planted at different densities; 3) to quickly assess the potential for developing genetic resistance and the time this would take; and 4) to rapidly incorporate resistance into commercially viable cultivars.

Infestation parameters

Measurements of immature-SLWF densities, honeydew stickiness levels and sooty mold quantities on foliage were taken randomly from each plot. Each parameter was scored according to a five-category scale (table 1).

We determined density of immature SLWF infestation by randomly removing stems from a plant and looking at the undersides of mature leaves. A score of "1" signifies no discernible immature whiteflies; a score of "2" indicates several immatures were found on occasional leaves; "3" indicates sev-

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eral immatures occurred on nearly every leaf or they were dense on occasional leaves; "4" indicates more than several immatures occurred on each mature leaf or they were dense on many leaves; and "5" indicates most mature leaves had at least 30 to 50% of the underside covered with immature SLWFs.

Stickiness level was determined subjectively by feeling plant surfaces. A score of "1" signifies no discernible stickiness; a score of "2" was given to plants with barely discernible stickiness on any surface; "3" indicates light but readily discernible stickiness on lower parts of the plant or very low levels on much of the plant; "4" indicates copious stickiness on lower plant or moderate stickiness on entire plant; and "5" indicates saturated or gooey buildup on most of the plant.

We visually measured sooty mold growth by looking at shaded foliage where mold might grow and ranked it on a scale of 1 to 5. A score of "1" signifies no discernible mold and "5" indicates the mold colonies were so dense as to appear continuous on the lower or shaded one-third or more of a plant.

Plant regrowth stage and spacing

Prior to our work, plant breeders had not studied the SLWF as a pest of alfalfa. Therefore, initial studies were performed to determine the best conditions to use in later breeding experiments. Our principal concern was to identify the stage of regrowth (time after cutting) that would provide the greatest information about differences in whitefly damage. In addition, because alfalfa breeding programs are commonly based on the evaluation or selection of individual plants, we wanted to determine the relationship between whitefly infestations in densely planted stands (similar to hay production fields) and in stands with plants spaced 1 foot or more apart. Replicated plots with dense and spaced alfalfa plantings were established at the DREC. Whitefly infestation parameters as previously described were measured on a weekly basis between June and September. Individual plots were scored for 7 weeks. While this is well beyond the normal period for hay production, it provided us with important information regarding both SLWF population development and the time when differences in plant response to the SLWF could be most accurately assessed.

The number of immature SLWFs and stickiness level of foliage increased at a very rapid rate for the first 3 to 4 weeks after cutting (fig. 1). Thereafter, both parameters continued to increase at a slower rate. Less than 3 weeks after cutting, both immature-SLWF density and stickiness level exceeded what we believe to be the economic threshold (average scores between 2 and 3). Sooty mold appearance and growth parameters lagged behind the increases in density of immature SLWFs and foliage stickiness. Spaced plantings exhibited much less sooty mold than dense plantings, probably due to lower humidity in the canopy. Numbers of immature whiteflies and stickiness of foliage in dense and spaced plantings were in close agreement.

These results gave us confidence that observations of immature-SLWF

TABLE 1. Description of scoring classes for evaluating silverleaf whitefly infestation parameters on alfalfa

Scoring Class*	Trait		
	Immature numbers	Stickiness level	Index
	no./cm²	*score*	*score*
1	0	None	None
2	< 1	Barely discernible	Some
3	< 50	Readily discernible	Many
4	< 100	Copious	Numerous
5	> 100	Saturated	Continuous

*Scores are based on the average infestation on a randomly chosen stem from each plant scored.

TABLE 2. Heritability estimates for silverleaf whitefly evaluation parameters measured either once or twice during the evaluation period at the UC Desert Research and Extension Center

Evaluation frequency	Trait		
	Immature numbers	Stickiness level	Index
	%		
Once	35.4	37.0	39.6
Twice	50.7	54.0	56.8

TABLE 3. Silverleaf whitefly resistance and forage yield of check materials and best populations selected for resistance to the silverleaf whitefly

Germplasm		Trait			
Identification	Characteristic	Whitefly damage		Forage yield	
		Index*	Rank†	lb/plot‡	Rank§
UC-2239	Cycle-3	2.3	2	2.1	8
UC-2230	Cycle-3	2.3	1	2.3	1
UC-2241	Cycle-3	2.4	5	2.3	2
UC-356	Parental source	2.6	12	—	—
UC-Cibola	Check	—	—	2.1	10
CUF-101	Check	2.7	17	2.2	3
Test mean		2.7		2.1	
LSD 0.05		0.2		0.3	
CV (%)		12.0		19.7	

*Index = [(stickiness level score) + (immature numbers score)]/2
†Rank among 21 entries in the trial
‡Average yield per cutting on a 100% dry weight basis
§Rank among 18 entries in the trial

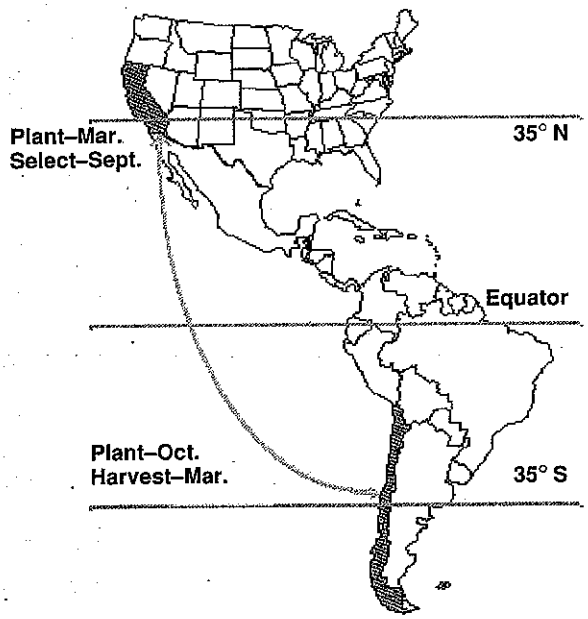

Fig. 3. Selection for resistance occurs in September at the Desert Research & Extension Center in California, and seed is harvested from those selections in March in a "winter" nursery south of Santiago, Chile.

densities and stickiness levels on individual plants in experimental plots are representative of what would occur in a hay production field. Evaluations were done after 3 weeks of regrowth. Sooty mold growth is not a useful measure for plant breeding purposes because it appears to depend on higher humidity than would normally be present in spaced plantings.

Studying the development of SLWF populations in alfalfa also provided valuable information regarding cultural management. Early cutting has been proposed as a means of controlling SLWF damage. The rationale was that this practice would break the lifecycle of the SLWF and would also remove the foliage (hay) before it becomes too sticky. Although normal monthly harvests do break the life cycle of SLWF on alfalfa, our studies indicate that honeydew stickiness levels reach an economic threshold as early as 2 weeks after cutting (fig. 1). Therefore, timely or even early harvest is unlikely to substantially reduce economic damage to alfalfa hay production. Early cutting would also produce low yields and over time would seriously reduce the stand.

Selection progress

Developing host-plant resistance to the SLWF was our highest priority, but we had virtually no information to guide our decisions about breeding methodology. We needed a reasonable understanding of the potential for developing resistance. Fortunately, the initial 73 selected plants had already set seed when they were identified. The seed was harvested from each individual plant, creating half-sib families. These families were then used to establish a study that would provide us with estimates of the genetic variability present among the selected plants. We then used those estimates to develop predictions of the rate at which we could increase resistance to the SLWF. Estimates of the rate of selection progress were made, assuming selection based on immature numbers, stickiness level, and an index score. The index score is the average of the stickiness and immature scores.

Estimates of heritability (percentage of a parent's characteristics for a trait passed to offspring) for immature numbers, stickiness level and the index score were all moderate (table 2). Heritability estimates and the rate at which resistance could be developed were both slightly higher for selection based on the index than for either individual parameter. This fits well with our desire to reduce both the size of the whitefly population that develops in alfalfa (and serves as a reservoir for infestation of other crops) and the stickiness of the foliage.

Environmental factors (e.g., location in the field, time of day) had a large influence on individual scores. This convinced us to devise a breeding program based on family selection rather than on selection among individual plants. Using the heritability values in table 2 and the corresponding estimates of genetic variability, predictions of selection progress were made for both half-sib family selection and selection among and within half-sib families (selection for the best families and then the best individuals from the best families). Selection progress was predicted to be most rapid with among-and-within half-sib family selection. Our observations from the regrowth and spacing study led us to set a goal of developing populations with mean index scores of 2 or less. Predictions of selection gain were then extrapolated for several years to determine how soon we might expect to identify economic levels of resistance. Approximately five cycles of selection will be required to reach our goal of a population with a mean SLWF-damage index of less than 2 (fig. 2).

For the past 4 years, we have established selection nurseries every March containing 10,000 to 15,000 individual plants in replicated half-sib families. Selection is based on the average of two observations on each plant, during August and September, for immature-SLWF density and stickiness level. Between 200 and 300 individuals are selected from the best 20% of the families based on the SLWF resistance index and agronomic type. These plants are dug in late September and transported under special permit to Chile.

Seed is produced under field conditions in "winter" nurseries in Chile that are harvested in March (fig. 3). Seed production on these plants during the summer in Chile permits us to produce as much as 500 times more seed than we could produce in a greenhouse during the winter in California. Consequently, we also obtain more rapid evaluation for forage yield and resistance to other economically important insects and diseases. This strategy permits us to concentrate our efforts on germplasm pools that have the greatest yield potential and to quickly improve, if necessary, other insect and disease resistance levels.

We have now completed three of the predicted five cycles of selection. Significant improvement has been made in resistance to the SLWF (table 3). This improvement is in almost exact agree-

NATIONAL ALFALFA VARIETY REVIEW BOARD
APPLICATION FOR REVIEW OF ALFALFA VARIETIES FOR CERTIFICATION

(The criteria for evaluation of applications were developed by the Joint Alfalfa Work Conference and the Association of Official Seed Certifying Agencies.)

Date September 12, 2000

Applicant's Name Larry R. Teuber

Address Agronomy & Range Science, University of California, Davis, CA 95616-8515

Telephone Number (916) 752-2461 FAX Number (916) 752-4361

Sponsoring Institution (if other than applicant) _____

Breeder's Name (if other than applicant) Larry R. Teuber, Larry K. Gibbs, Ken L. Taggard

Variety Name UC-Impalo-WF Experimental Designation(s) UC-2458 (pre-breeder, Syn-1), UC-2531(breeder, Syn-2), UC-2598(foundation, Syn-3), UC-2681(certified, Syn-4)

Applicant's Signature _____

The breeder or sponsoring institution or organization must describe the DOCUMENT in this application those characteristics of the variety which give it distinctiveness and merit by supplying the information requested below. Information must be supplied for each category excepting those listed as optional. Action will be deferred unless the application is sufficiently documented.

I. A. Estimate the % of the germplasm sources listed below that contribute to the major genetic constitution of this variety.

M. falcata	Ladak	M. varia	Turkistan	Flemish	Chilean
0	0	1	8	0	7

Peruvian	Indian	African	Arabian	Unknown
1	15	35	10	23

B. A statement of origin describing breeding procedures or methods and selection criteria used in developing the variety. Statement should include the following:

1. Breeding method
2. Number of plants in synthetic variety
3. Selection criteria–specific traits. Indicate race/strain of pests used in selection.
4. Germplasm sources and % (number of plants)
5. Breeder seed production
   a. How seed was bulked (e.g. equal weight of seed from each clone)
   b. Synthetic generation of breeder seed (e.g. Syn 1, Syn 2, etc.)
   c. Years of breeder seed production

II. B. Statement of origin:

Parent material for 'UC-Impalo-WF' was UC-356 a breeding mixture composed of 346 plants from 9 different UC breeding pools (UC-127, 25plants; UC-295, 13 plants; UC-329, 52 plants, UC-330, 51 plants, UC-332, 65 plants; UC-340, 51 plants; UC-342, 60 plants; UC-344, 1 plant, and UC-346, 28 plants). Selected plants were placed in an isolated crossing block at the Desert Research and Extension Center in 1989 and seed harvested from individual plants in 1990. Half-sib families of each of the component plants were planted in four replicates in the spring of 1991. In October 1992, Seventy-six plants were selected for resistance to the Silverleaf Whitefly (*Bemisia argentifolii*) from a nursery of approximately 15,000 plants. Between 1993 and 1996 three additional cycles of selection were completed for resistance to the silverleaf whitefly and for increased seed production. Selection for resistance was practiced using "among and within half-sib family selection" in field nurseries at the Desert Research and Extension Center. The soil in this part of DREC is an Imperial sandy clay loam (Fine, montmorillonitic (calcareous), hyperthermic Typic Torrifluvents) with an electrical conductivity of 0.7, 0.8, and 0.9 S m^{-1} in the top 30, 60, and 90 cm, respectively. In each cycle of selection 250 to 300 families were screened in replicated nurseries and the best 200 to 300 individuals selected from the top 15 to 21 families. Selected individuals were taken to Chile for seed production and low intensity screening for seed production. Seed from the selected individuals and selected elite families was used to construct the next years breeding nursery. Pre-breeder seed (UC-2458, syn-1)produced on Chile and harvested in March 1997 from 186 plants selected in September 1996 at DREC. Breeder seed (UC-2531) was produced in March 1998 in Chile from UC-2458. Foundation generation seed was initially produced at the Kearney Research and Extension Center (Parlier, CA) in September 1998 (UC-2598), and Certified generation seed was harvested in March 1999 in Chile and September 1999 in Brawley, CA (UC-2681, syn-4). These seed lots were used to produce the documentation in this application.

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C. Seed class to be used, limitations on age of stand and areas of production for each class.

Seed Class	Synthetic Generation	Length of Stand Allowed	Limitation on Areas for Seed Production
Breeder	2	1	(Produced - 1998)
Foundation	3	3	Seed production limited to San Joaquin Valley of California south of 37°25′ N latitude and Riverside and Imperial counties of California south of 34°00′ N latitude.
Certified	4	3	Seed production limited to San Joaquin Valley of California south of 37°25′ N latitude and Riverside and Imperial counties of California south of 34°00′ N latitude.

Only the synthetic generations given for the above seed classes are recognized as representing this variety. No supporting data should be used in this application from Syn. generations other than those for the Breeder, Foundation, and Certified classes listed here.

D. Procedures for maintaining seed stock: (Indicate year of breeder seed production and who will maintain breeder seed.)

The only seed classed as Breeder seed is that produced by the University of California Alfalfa Genetics and Breeding program from UC-2458. Sufficient seed for the expected life of the variety has been produced and is in cold storage at the Agronomy and Range Science Field Facility, Davis CA, and the Desert Research and Extension Center, El Centro, CA. Foundation seed will be maintained by the University of California Foundation Seed Project, or its designee.

E. Any other requirements or limitations necessary to maintain varietal characteristics?

Seed production limited to San Joaquin Valley of California south of 37°25′ N latitude and Riverside and Imperial counties of California south of 34°00′ N latitude.

II. A. Describe the primary use of this variety. (If for uses other than hay, haylage, greenchop, or dehydration, additional claims will require data in III. D.)

Primary use is for hay, haylage, greenchop, or dehydration.

B. List states and areas within states where tested for forage and/or persistence. (Present data from each location in III. A. and III. B.)

California:, San Joaquin Valley, and Imperial Valley. Southwest Arizona

C. List:

1. Areas of adaptation must be supported by test locations and data. (Use PVP map and terminology for areas of adaptation.)

Area 4 - Southwest, but claim for adaptation is restricted within this broad area.

2. Areas of intended use.

Low Desert alfalfa production areas of California and extreme Southwest Arizona.

III. Evidence of agronomic performance, including data on yield (in T/A) and persistence. Data may be from tests conducted by private firms, Agricultural Experiment Stations, or USDA.

A. Minimum required forage yield data is six location years with at least two locations. (Two locations must be at least 100 miles apart. If the variety is designated for a limited area of use, the 100-mile restriction may be relaxed, however, there must be a strong justification and documentation accompanying such a request.) Seeding year forage yield data cannot be used to satisfy this requirement. One location must have at least two harvest years beyond seeding year. Each harvest year should be listed separately.

Note: For non-dormant varieties (dormancy level of Moapa 69 or CUF 101) seeding year data may be accepted for up to two of the six location years when four or more cuttings are made in the seeding year.

Summarize Forage Yield Data below:

Test Location	Date Planted Mo/Yr	Syn Gen	Year Hvst	No. Cuts	Total Yield (DM T/A)* 1. This variety	2. CUF101	3. Highline	4. UC Cibola	LSD .05	CV%
Imperial, CA	11/98	3	1999	8	12.46	11.84	12.01	12.58	0.33	11.1
DREC			2000	7	8.65	8.188	8.38	8.40	0.24	9.6
Imperial, CA	5/99	3	1999	4	5.15	5..37	5.41	5.23	0.38	10.4
DREC			2000	7	8.97	9.66	9.55	9.48	0.23	8.3
Imperial, CA	11/99	3	2000	6	9.89	10.42	9.78	9.67	0.32	8.6
DREC										
Maricopa, AZ	10/98	3	1999	7	17.19	15.53	15.95	--	1.09	6.01
University of Arizona			2000	6	16.21	16.88	17.90	--	1.48	5.65
Five Points, CA WSARC	9/98	3	1999	4	5.78		5.86	--	0.63	8.5

* data collection not reported after August harvest in 2000.

Performance in all reported areas of evaluation.

	Number of Years Harvested	Total Number of Harvests	Mean Annual Yield This variety			
Ck 2 Comparison	7	45	11.22	11.13		
Ck 3 Comparison	7	49	10.54		10.61	
Ck 4 Comparison	5	32	9.02			9.07

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B. Persistence.

Enter dates of both initial and final stand estimates. Data must come from the area of adaptation and from stands at least 24 months old. Comparison data is needed on two (2) check varieties.

Test Location	Syn Gen	Date Seeded Mo/Yr	Number of Years Harvested	Number of Harvests	Date of Readings (Mo/Yr) Initial/Final	% Stand: This Variety Initial/Final	% Stand: Check Varieties: CUF 101 Initial/Final	% Stand: Check Varieties: UC Cibola Initial/Final	LSD .05	CV%
Imperial, CA† DREC	3	10/98	2	13	(3/99)/(9/00)	100/95	100/90	100/90	1.5/2.8	1.9/2.2

†data reported as percentage cover based on a 1 to 10 each increment approximates 10% cover. Initial stand counts of 25 plants per 1/10 m^2 or greater are considered 100% stand

C. Fall dormancy as determined from spaced plantings relative to three (3) standard check varieties; check varieties must be chosen so as to bracket the dormancy data of this variety.

1. Test data

Test Location	Syn Gen	Date Last Cut (Mo/Yr)	Date Measured (Mo/Yr)	Score or Average Height: This Variety	Check varieties: 10. UC-1887	Check varieties: 9. CUF 101	Check varieties: 8. Pierce	LSD	CV%
Tulelake, CA (IREC)	3	9/99	9/99	2.70	2.85	2.80	2.65	0.125	3.68
UCD-Davis, CA	3	10/99	10/99	2.96	3.22	2.96	2.89	0.123	3.36
Imperial, CA DREC	3	10/99	11/99	2.32	2.42	2.30	2.14	0.210	7.46
All location Mean	3	NA	NA	2.66	2.83	2.69	2.56	0.17	5.07

*Spaced plants clipped back on September 7, October 3, and October 23, respectively and scored 24 days later.

Scoring system used: 1 to "N" visual score with each scoring increment equal to 5 cm of vertical height. Trial conducted according to Standard Test Procedures to Characterize Alfalfa Cultivars.

2. Indicate which of the following fall dormancy classes this variety is most similar to.

VERY DORMANT	DORMANT	MODERATELY DORMANT	NON-DORMANT	VERY NON-DORMANT
FD1 ( )	FD2 ( ) FD3 ( )	FD4 ( ) FD5 ( ) FD6 ( )	FD7 ( ) FD8 ( )	FD9 (X) FDR = 8.7

FDR is calculated from NPH according to the regression FDR = 6.289*(NPH) – 8.0789. Reference University of California Agronomy progress report 267 December 1999.

D. Special claims (winter survival, forage quality, grazing tolerance, etc.).

1. Winter survival as determined from spaced plantings relative to standard check varieties; check varieties must be chosen so as to bracket the winter survival data of this variety. Data for check varieties in classes 2, 4 and 6 must be included. This claim must be supported by data from a minimum of two (2) station years.

Test Location	Syn Gen	Date Planted (Mo/Yr)	Date Measured (Mo/Yr)	This Variety	Winter survival rating — Check class 1	2	3	4	5	6	LSD .05	CV%

None

Note the check variety used for each class (x). also indicate the winter survival class to which this variety is most similar {X}.

1{ } Extremely winterhardy	2{ } Very winterhardy	3{ } Winterhardy	4{ } Moderately winterhardy	5{ } Low winterhardy	6{ } Non-winterhardy
Beaver ( )	OAC Minto ( )	Apica ( )	Fortress ( )	Archer ( )	CUF 101 ( )
Maverick ( )	Vernal ( )	Dart ( )	G2852 ( )	S. Special ( )	Moapa 69 ( )
Norseman ( )	526 ( )	Ranger ( )	WL316 ( )	Sutter ( )	5929 ( )

2. Forage quality as determined from replicated seeded plots relative to standard check varieties. Claims must be supported by data from at least two (2) location years (see standard test). Each harvest year should be listed separately (use unweighted annual means).

Test Location	Date planted Month/Year	Syn Gen	Year Hvst	No. Cuts	This Variety	1. _____	2. _____	3. _____	LSD .05	CV%

ADF

No Claim

Mean _____

NDF

Mean _____

RFV

Mean _____

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IV.Other descriptive characteristics

A. Flower color at full bloom. Syn. generation observed Syn 4

(See USDA Agriculture Handbook No. 424 — A System for Visually Classifying Alfalfa Flower Color.)

98 % purple	≤ 1 % cream	0 % yellow
≤ 1 % variegated	0 % white	

B. Document other distinctive characteristics such as pod, leaf, or root traits, biochemical markers, etc.

1. Multifoliolate leaf expression as determined on spaced plants relative to standard check varieties. Check varieties must be chosen so as to bracket the multifoliolate leaf expression data of this variety

MULTIFOLIOLATE LEAF EXPRESSION

Test conducted by _____ at _____

Variety	MF Class	Year Tested	Syn Gen	MF1	%MF
Test Variety					
1.	Not applicable				
2.					
3.					
	Test Mean:				
	L.S.D. (.05)				
	C.V. (%)				

Indicate which of the following check varieties this variety most nearly compares to in multifoliolate leaf expression (X).

High MF	Moderate MF	Low MF	Trifoliate
Proof ( )	MultiKing I ( )	Legend ( )	Vernal ( )

V. Pest resistance characteristics.

PLEASE FOLLOW THESE INSTRUCTIONS CAREFULLY WHEN REPORTING PEST RESISTANCE RESULTS.

Furnish comparative data on the following insects, diseases, and nematodes (include others where applicable) for your variety. Data may be from tests conducted by private firms, Agricultural Experiment Stations or USDA. Tests must be conducted by standard procedures and scoring systems as described in the **NAAIC Standard Tests to Characterize Alfalfa Cultivars, 3rd Edition**, as amended, 1995. Each disease, insect, and nematode test must include designated resistant and susceptible checks. Tests using unadjusted data showing a resistant or susceptible check falling outside of acceptable ranges will not be accepted. Statistics must include the test mean (mean of all entries in test), LSD (.05), and CV (%) for unadjusted % resistance and ASI data that are reported. All data is to be adjusted based on the resistant check. Resistance levels should be characterized using % resistant plants as follows: S = <6%, LR = 6-14%, MR = 15-30%, R = 31-50%, HR = >50%. Do not refer to tolerance. Checks must be characterized based on long term % resistance averages published in the **NAAIC Standard Tests to Characterize Alfalfa Cultivars, 3rd Edition**, as amended, 1995. Use the following formula:

$$\frac{\text{Adjusted \% R Check}}{\text{Unadjusted \% R Check}} \times \text{Unadjusted \% R Variety} = \text{Adjusted \% R Variety}$$

Note: If a pest reaction of the variety falls on or just above an adjusted resistance category level (+2% for LR, MR, and R; +3% for HR) and the higher rating is claimed, results of a second test must be reported. If the two tests do not agree, the lower rating is appropriate unless further testing supports the higher rating. Pest resistance data must be approved on at least six of the following pests: anthracnose (race 1), bacterial wilt, Fusarium wilt, Verticillium wilt, Phytophthora root rot, stem nematode, pea aphid, spotted alfalfa aphid, blue alfalfa aphid, Aphanomyces root rot (race 1), root-knot nematode. Further traits to characterize the variety may be submitted. For pests where not data is available, enter: "**Not Tested**." The six required pests **must** be selected from those that frequently cause significant losses on susceptible cultivars in the area of intended use of this variety. (Compare with the maps of distribution and severity of alfalfa pests in the **NAAIC Standard Tests to Characterize Alfalfa Cultivars, 3rd Edition**, as amended, 1995. This will determine for which pests you must submit resistance information.)

Applicants wishing to submit revisions or additions to previous applications should use an approved form entitled Application for Amendment to Original Applications.

ANTHRACNOSE (Race 1)

Test conducted by Crop Characteristics, Inc. at Farmington, MN

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	"LR"	2000	4	12.8	11.4	
1. Arc	HR			72.8	65.0	
2. Saranac AR	R			40.3	35.9	
3. Saranac	S			1.8	1.6	
	Test Mean:			35.3	31.5	
	L.S.D. (.05)			7.2	6.4	
	C.V. (%)			14.5	14.5	

Test conducted in field Lab X

* * * * *

BACTERIAL WILT

Test conducted by Crop Characteristics, Inc. at Farmington, MN

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	"MR"	1999	3	22	19	2.6
1. Vernal	R			49	42	1.6
2. Sonora	S			2	2	3.5
3. Naragansett	S			3	2	3.4
	Test Mean:			43.0	36.9	1.94
	L.S.D. (.05)			11.1	9.5	0.36
	C.V. (%)			18.4	18.4	13.40

Test conducted in field X Lab

* * * * *

FUSARIUM WILT

Test conducted by Crop Characteristics, Inc. at Northfield, MN

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	"HR"	1999	3	63	57	1.4
1. Moapa 69	HR			65	58	1.2
2. Agate	HR			60	54	1.2
3. MNGN1	S			6	5	2.6
	Test Mean:			52.5	47.2	1.44
	L.S.D. (.05)			10.9	9.8	0.32
	C.V. (%)			14.7	14.7	15.8

Test conducted ~~in field~~ X ~~Lab~~

VERTICILLIUM WILT

Test conducted by _____ at _____

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	Not Tested					
1.						
2.						
3.						
	Test Mean:					
	L.S.D. (.05)					
	C.V. (%)					

Test conducted in field Lab _____

* * * * *

PHYTOPHTHORA ROOT ROT

Test conducted by Crop Characteristics, Inc. at Farmington, MN

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	"R"	2000	4	35.6	35.0	3.2
1. Agate	R			43.8	43	2.9
2. Saranac	S			6.5	6.4	3.8
3.						
	Test Mean:			30.2	29.6	3.21
	L.S.D. (.05)			7.7	7.6	0.38
	C.V. (%)			18.0	18.0	8.4

Test conducted in field Lab X

* * * * *

STEM NEMATODE

Test conducted by _____ at _____

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	Not Tested					
1.						
2.						
3.						
	Test Mean:					
	L.S.D. (.05)					
	C.V. (%)					

Test conducted in field Lab _____

PEA APHID

Test conducted by Crop Characteristics, Inc. at Farmington, MN

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	"R"	2000	4	44.4	47.4	3.2
1. CUF 101	HR			51.6	55.0	3.1
2. PA-1	R			42.3	45.1	3.4
3. Moapa 69	S			6.1	6.5	4.0
	Test Mean:			33.4	35.6	3.50
	L.S.D. (.05)			8.3	8.8	0.3
	C.V. (%)			16.2	16.2	4.7

Test conducted in field Lab X

* * * * *

SPOTTED ALFALFA APHID

Test conducted by Crop Characteristics, Inc. at Farmington, MN

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	"HR"	2000	4	55.0	65.6	2.5
1. CUF 101	HR			50.3	60.0	2.8
2. Caliverde	S			0	0	5.0
3.						
	Test Mean:			34.6	41.3	3.34
	L.S.D. (.05)			10.4	12.4	0.34
	C.V. (%)			18.7	18.7	6.3

Test conducted in field Lab X

* * * * *

BLUE ALFALFA APHID

Test conducted by Crop Characteristics, Inc. at Farmington, MN

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	"R"	2000	4	37.2	49.8	3.2
1. Caliverde	S			2.2	3.0	4.0
2. PA -1	LR			8.3	11.2	3.9
3. CUF 101	HR			41.1	55.0	3.3
	Test Mean:			22.9	30.6	35.5
	L.S.D. (.05)			8.0	10.7	0.2
	C.V. (%)			24.8	24.8	4.8

Test conducted in field Lab X

APHANOMYCES ROOT ROT (Race 1)

Test conducted by _____ at _____

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	Not Tested					
1.						
2.						
3.						
	Test Mean:					
	L.S.D. (.05)					
	C.V. (%)					

Test conducted in field Lab _____

* * * * *

ROOT-KNOT NEMATODE -- Species: *Meloidogyne incognita*

Test conducted by Crop Characteristics, Inc. at Farmington, MN

Variety	Resistance Class	Year Tested	Syn Gen	Unadjusted % R	Adjusted % R	Score or A.S.I
Test Variety	"R"	2000	4	44.2	42.0	1.7
1. Moapa 69	R			52.4	50.0	1.6
2. Lahontan	S			0	1.2	2.8
3.						
	Test Mean:			26.8	25.5	2.20
	L.S.D. (.05)			12.5	11.9	0.24
	C.V. (%)			29.1	29.1	7.0

Test conducted in field Lab X

* * * * *

OTHER PEST EVALUATIONS

Silverleaf Whitefly (Bemisia argentifolii)

Test conducted by University of California at Desert Research and Extension Center, EL Centro, CA

Variety	Resistance Class	Year Tested	Syn Gen	Stickiness ASI	Immatures ASI	Index ASI
Test Variety	"R"	1999	3	3.16	3.29	3.23
1.UC-2558	R			2.87	2.49	2.68
2.CUF-101	S			3.68	4.10	3.89
3.UC-WF-4	S			3.80	3.95	3.87
	Test Mean:			3.21	3.34	3.33
	L.S.D. (.05)			0.34	0.52	0.39
	C.V. (%)			7.0	11.0	7.8

Test conducted in field X (see attached NAAIC protocol) Lab _____

Please attach a one-page description/summary of your variety as you wish it published by AOSCA. This description must stand on its own. Please state the variety name and date submitted; if it is an amended description type: (Amended) after the variety name. Use complete sentences, and number each item following the format given below.

Include the following:

1. A statement of genetic origin (including variety names, germplasm releases, and/or PI numbers that contributed to the major genetic constitution of this variety) and the breeding procedures, methods, and selection criteria used in developing the variety. Estimate the % of the major germplasm sources contributing to this cultivar (see I. A.).

2. Area of probable adaptation (geographic area) and primary purpose (if other than hay, haylage, green chop, or dehydration) for which this variety will be used. Report states where the variety has been tested for yield and proposed areas of intended use.

3. Descriptive characteristics such as fall dormancy, flower color, and any other morphological or physiological characteristics that may be used as identifying traits. Indicate Syn generation of flower color determined.

4. A statement relative to the varieties resistance to anthracnose (Race 1), bacterial wilt, Fusarium wilt, Verticillium wilt, Phytophthora root rot, stem nematode, pea aphid, spotted alfalfa aphid, blue alfalfa aphid, Aphanomyces root rot (Race 1), root knot nematode, and other evaluated pests. Races and species should be indicated if known to exist.

5. Procedures for maintaining seed stock, seed classes to be used, a statement as to the limitation of age of stand and generations that may be certified, other requirements or limitations necessary to maintain varietal characteristics, and who will maintain seed stocks of the variety. The year of breeder seed production should be indicated.

6. If this variety is accepted by official certifying agencies, when will certified seed first be offered for sale?

7. Will application be made for protection under the Plant Variety Protection Act, and if so, will the certification option be requested?

8. As a means of added varietal protection, are you willing to have the information in this application turned over to the PVP office?

9. Variety name: Date submitted:
   Experimental designations:

20000353

Attachment I

Description of cultivar:

This cultivar is a broad based germplasm pool developed by four cycles of among and within half-sib family selection from within a breeding population designated UC-356. UC-356 was developed from nine different source pools in the University of California alfalfa breeding program. The component populations had previously been selected for resistance to saline soil conditions, root knot nematode (*Meloidogyne* sp.), Phytophthora root rot (*Phytophthora megasperma*), bacterial wilt (*Clavibactor insidiosum*), and Fusarium root rot (*Fusarium oxysporum*), blue alfalfa aphid (*Acyrthosiphon kondoi*), Pea aphid (*Acyrthosiphon pisum*), spotted alfalfa aphid (*Threioaphis maculata*), and forage yield and adaptation in the low desert production area of California and Arizona. This germplasm pool is composed of: 0%, *M. falcata*: 0%, Ladak; 1%, *M. varia*; 8%, Turkistan; 0%, Flemish; 7%, Chilean; 1%, Peruvian; 15%, Indian; 35%, African; 10%, Arabian; and 23%, unknown sources of germplasm.

This cultivar is adapted to Low Desert irrigated production areas. It has been tested in the Imperial and San Joaquin Valleys of California, and Central Arizona. It is intended for hay, haylage, greenchop, or dehydration. The target market area will be the Low Desert irrigated alfalfa production areas of California and Extreme South Western Arizona.

This cultivar is very nondormant (group 9) with a Fall Dormancy rating of 8.7 based on University of California Dormancy Trials, Flower color is predominantly purple (98%) with a trace of Variegated types (≤ 1%) and a trace of Cream (< 1%). Flower color data were determined on Syn. 4 (UC-2681).

It is highly resistant to Fusarium wilt (*Fusarium oxysporum*) and spotted alfalfa aphid (*Threioaphis maculata*). It is resistant to Phytophthora root rot (*Phytophthora megasperma*), blue alfalfa aphid (*Acyrthosiphon kondoi*), pea aphid (*Acyrthosiphon pisum*), and southern root knot nematode (*Meloidogyne incognita*), and the silverleaf whitefly (*Bemisia argentifolii*). It is moderately resistant to bacterial wilt (*Clavibactor insidiosum*) and has low resitance to southern anthracnose (*Colletotrichum trifolii*) (Race 1). Resistance of this cultivar to Verticillium wilt (*Verticillium albo-atrum*) and Aphanomyces root rot (Race 1) (*Aphanomyces euteiches*) is unknown. This cultivar is equal in yield to the Cultivars CUF 101 and Highline and is the first cultivar with substantial resistance to the Silverleaf Whitefly. It has been field tested by growers on over 500 acres in Imperial county and has been generated strong grower enthusiasm.

Seed classes of this cultivar will be Breeder (produced in a field isolation in 1998), Foundation and Certified. Breeder and Foundation seed classes will be maintained by the University of California Foundation Seed Project, Davis or its designee. Foundation and Certified seed production are each limited to a 3-year stand life. Seed production of both Foundation and Certified classes is limited to the San Joaquin Valley of California south of 37°25'N latitude and Riverside and Imperial counties of California south of 34°00'N latitude.

Certified seed will first be offered for sale in 2000.

Variety name: UC-Impalo-WF
Experimental Designations: UC-2458 (pre-breeder, Syn-1), UC-2531(breeder, Syn-2), UC-2598(foundation, Syn-3), UC-2681(certified, Syn-4)

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

EXHIBIT E
STATEMENT OF THE BASIS OF OWNERSHIP

The following statements are made in accordance with the Privacy Act of 1974 (5 U.S.C. 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF APPLICANT(S)	2. TEMPORARY DESIGNATION OR EXPERIMENTAL NUMBER	3. VARIETY NAME
The Regents of the University of California	UC-2598	UC-Impalo-WF

4. ADDRESS *(Street and No., or R.F.D. No., City, State, and ZIP, and Country)*	5. TELEPHONE *(include area code)*	6. FAX *(include area code)*
1111 Franklin Street 12th Floor Oakland, California 94607-5200	510-587-6000	510-587-6090

7. PVPO NUMBER 200000353

8. Does the applicant own all rights to the variety? *Mark an "X" in appropriate block.* If no, please explain. [X] YES [ ] NO

9. Is the applicant (individual or company) a U.S. national or U.S. based company? [X] YES [ ] NO
If no, give name of country

10. Is the applicant the original owner? [X] YES [ ] NO *If no, please answer one of the following:*

a. If original rights to variety were owned by individual(s), is (are) the original owner(s) a U.S. national(s)?

[ ] YES [ ] NO If no, give name of country

b. If original rights to variety were owned by a company(ies), is(are) the original owner(s) a U.S. based company?

[X] YES [ ] NO If no, give name of country

11. Additional explanation on ownership *(if needed, use reverse for extra space)*:

PLEASE NOTE:

Plant variety protection can be afforded only to owners (not licensees) who meet one of the following criteria:

1. If the rights to the variety are owned by the original breeder, that person must be a U.S. national, national of a UPOV member country, or national of a country which affords similar protection to nationals of the U.S. for the same genus and species.

2. If the rights to the variety are owned by the company which employed the original breeder(s), the company must be U.S. based, owned by nationals of a UPOV member country, or owned by nationals of a country which affords similar protection to nationals of the U.S. for the same genus and species.

3. If the applicant is an owner who is not the original owner, both the original owner and the applicant must meet one of the above criteria.

The original breeder/owner may be the individual or company who directed final breeding. See Section 41(a)(2) of the Plant Variety Protection Act for definition.